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ABSTRACT

Twenty-six students who were tutored in freshman mathematics were matched with twenty-six students who did not visit the tutor during the semester. Findings showed that students who received tutorial assistance got significantly higher ($p < .05$) final grades than the students not receiving help. (DT)

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ABSTRACT

A Research Practicum Presented to Nova University
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Education

THE EFFECTS OF A STUDENT TUTOR PROGRAM UPON LEARNING IN FRESHMAN MATHEMATICS

by

James G. Troutman

February, 1977

LEARNING THEORY AND APPLICATIONS EASTERN PENNSYLVANIA

York College of Pennsylvania has an "open door" admissions policy. As a result of this policy many educationally disadvantaged students have been enrolled in freshman mathematics courses. To provide academic support and individualized assistance the college instituted a student-to-student tutorial program in the fall of 1976. The purpose of this practicum was to examine the effects of the student tutorial program on academic achievement in freshman mathematics.

A group of twenty-six students who had visited the tutor three or more times was chosen as the experimental group. This group was matched with another group of twenty-six students who did not visit the tutor during the semester. A matched pairs sampling technique was used.

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A statistical analysis was conducted to test the significance of the difference between the mean of the final grades of those students who visited the tutors with those who did not visit the tutors. In particular, the analysis was designed to test if there was a significantly higher mean for those who received the tutorial assistance.

The findings of this research showed that at the 0.05 significance level those students who received tutorial assistance achieved higher final grades, in percent scores, than those students who did not receive tutorial assistance. The mean of the group receiving tutorial assistance was almost eight percentage points higher than the mean of the group not receiving tutorial assistance.

The recommendations that were made as a result of this research included 1) that the mathematics tutorial program be expanded to other departments and disciplines, 2) that the tutorial assistance program be located at a central campus facility to make it available for more student access, and 3) that a rigorous tutor selection and training program be considered.

The Effects of a Student Tutor Program Upon Learning in Freshman Mathematics

Learning Theory and
Applications

by

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York College of Pennsylvania

DR. KENNETH MILLER

EASTERN PENNSYLVANIA

A PRACTICUM PRESENTED TO NOVA UNIVERSITY
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF EDUCATION

NOVA UNIVERSITY

FEBRUARY 1977

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INTRODUCTION

Statement of the Problem

This paper examined the effects of the student tutorial program on academic achievement in freshman mathematics courses at York College of Pennsylvania. The basic question that was attacked was does the student tutorial program aid the students to learn the material in the freshman mathematics courses.

Significance to York College

York College has a liberal admission policy. As a result of this policy the mathematics courses are geared to several levels. The Calculus is offered to student who enter with the normal college preparatory background. Finite Mathematics and College Algebra are offered to those students who had business, vocational or other non-college preparatory backgrounds. A review of arithmetic and basic algebra is offered to those students who have a weak background in mathematics.

Each faculty member is required to schedule a minimum of five hours per week in which to work in small groups and individually with students. A student tutorial program was implemented experimentally during the fall 1976 semester. This program has provided an additional source for students who desire and require additional assistance in their academic work.

York College is a small private institution and as a result has the usual financial limitations of similar private schools. A program of student tutors for fifteen hours per week results in a yearly minimum expense of $900. This cost is somewhat less than cost and manpower necessary for an audio-tutorial program. In addition this money is paid to students who need it to help finance their education at York College.

Finally, and most importantly, it was hoped that this research would demonstrate that the learning process for York College students was improved. Working with their peers and taking advantage of other learning options at the college should provide the student with a better learning experience. In addition, some students who previously could not meet the academic requirements of a college education now will have an added opportunity to succeed. This would reduce the freshman attrition rate at the college.

Method of Investigation

A statistical analysis was conducted to test the significance of the difference between the mean of the final mathematics grades of those students who visited the tutors and those students who did not. In particular, the analysis was designed to test if there was a significantly higher mean for those who visited the tutor as compared to the mean of those who did not. A one-tailed t test was conducted at the 0.05 significance level. For details of the procedures

the reader is directed to the Procedures and the Results sections of this paper.

BACKGROUND AND SIGNIFICANCE

The Tutorial Program

During the fall 1974 semester the Student Resource Center began providing free tutorial service to the students of the college. The student tutors were volunteers working free except for an occassional Veterans Administration Tutorial Assistance Allowance. Even though there were some problems with finding enough qualified tutors the program was successful and well received by the students.

In the fall 1976 the Physical Science Department experimentally took over the mathematics tutorial portion of this program. The tutors were selected on a basis of mathematics background and financial need. The students were paid a minimum salary to serve as tutors. The two tutors worked from fifteen to twenty hours per week in the afternoons and evenings.

There were approximately 620 students enrolled in freshman mathematics courses during the fall of 1976. Sixty-nine students visited the tutors at least once. Twenty-nine students visited the tutors three or more times. Of these twenty-nine, three withdrew, leaving a population of twenty-six to study for this paper.

Review of the Literature

Much of the recent literature in learning theory suggest several ways in which peer tutorial programs will benefit learning. Repetition has an importance to learning as it is associated with retention of knowledge. Frederick J. McDonald (1965:235-236) cites experimental evidence to suggest that spaced but frequent reviews immediately following initial learning, followed by widely spaced "brush-ups" during the period of desired retention, represents the most effective approach to learning. Morris L. Bigge (1976:317) echoes this sentiment when he writes:

> Since the rate of forgetting is much more rapid relatively soon after the initial learning, we may hypothesize that review periods should follow immediately after the initial learning and not be delayed.

This phenomena of forgetting is also considered by Earnest R. Hilgard and Gordon H. Bower (1975:392-393):

> The amount forgotten increases with the time that has elapsed since the end of practice, and the amount of session-to-session forgetting becomes progressively less as daily practice on a task continues.

The use of a peer as a tutor has some distinct advantages pointed out in the literature. Guy R. Lefrancois (1972:297) states the following concerning peer imitation:

> ...if a model engages in a behavior there must be some reinforcement that leads him to do so and that reinforcement will also result if the observer imitates the behavior.

The use of reinforcement is a characteristic of B. F. Skinner and again Lefrancois (1972:97) wrote this about reinforcers:

> Stated very simply, the model of operant conditioning says that when a response - regardless of the conditions that might or might not have led to its emission - is followed by a reinforcer, the results will be an increase in the probability that the response will occur again under similar circumstances.

The review of the literature concerning tutorial programs supports the literature in learning theory. A study by Robert M. Wright (1971) at Northeast Missouri State College involved 799 freshmen. The students were chosen as predictably unsuccessful and received tutoring and advising in English, mathematics, social science and science by competent upper-division students. The results of the study indicated that the methods used was relatively effective for raising achievement levels for a substantial number of freshmen and sophomores in certain required courses. Students predicted lowest in achievement profited least from tutoring or did not take advantage of it. Those in the average range seemed to profit most and had the highest record of participation. The number of students placed on academic probation or suspension was significantly reduced with the introduction of the tutorial program. Individual attitude and relative motivation were given as contributing factors for the higher achievement levels.

Madan Mohan (1972) reported on research conducted at the State University of New York, Fredonia. The study concluded that peer tutoring had a significantly favorable

effect on school achievement, motivation and the attitude of unmotivated students. The study showed no favorable changes in self-concept of the student. The program was enthusiastically accepted by the teachers and students of the college.

A study undertaken by L. Morrison (1974) at the State University College at Oswego, New York, evaluated the special tutorial programs enhancement of academic success of special program students. The results were that the program had been fairly successful in enhancing the academic achievement of persisting special program students. In addition, the study supports the argument that the chances for success for educationally disadvantaged students are greatly increased when they are placed in a program designed to meet their academic, financial, cultural and social needs.

Allan MacDougall (1974) made a study of 351 students at Southwestern College in Chula Vista, California. The results of the study indicated that a tutorial program significantly affected the decrease in the number of student withdrawls. The tutorial program also significantly increased the number of passing grades (A, B, C, D). Also the tutorial program significantly increased the number of successful grades (A, B, C). However, there was no significant increase in the high grade range (A, B).

Robert A. Carman (1974) made a study at Santa Barbara City College, California, concerning 190 students

in freshman mathematics who received tutorial assistance. His findings showed that grades were significantly increased only if withdrawls were not included. Also, 62.9 percent of the students not receiving tutorial assistance withdrew while only 39.1 percent of the students receiving tutorial assistance withdrew. The study also indicated that those students receiving tutorial assistance in mathematics had significantly fewer withdrawls in other subjects. It was also shown that tutorial assistance gave students a much more positive attitude towards mathematics as well as other subjects.

Summary of the Literature

The literature consistently points to two areas of improvement caused by tutorial programs. The first is academic achievement as measured by grades. This is brought out in a study conducted by Etters (1967) at Parsons College. The Parsons College tutorial program was designed to offer tutorial services to all students but particularly to low-achievers. He found that tutoring increased the grade point average of low achievers when used in conjunction with reduced course loads.

The second area of improvement is persistence of students. Meister and Tauber (1965) found in their study of the college discovery program at Bronx Community College and at Queensborough Community College, that the attrition rate for students in the program was low. They concluded

that the high retention rate was due to tutoring and motivation.

R. Reed (1974:39) conducted a survey of 110 two-year and four-year colleges that had peer tutoring programs. He concluded that:

> Few tutorial programs have conducted systematic evaluation of their effectiveness. This may be attributed in part, to difficult of measuring the impact of a single program when there are several intervening variables and, in part, to a lack of money or personnel necessary to conduct a rigorous and meaningful evaluation.

W. C. Stainback (1975) examined seventeen student-to-student tutoring programs and concludes:

> In summary, it can be said that additional research that is more tightly controlled is needed before position papers advocating student-to-student tutoring as a means to individualized instruction can be realistically evaluated. This conclusion is based on the ambiguous findings and obvious limitations of some of the research conducted to date.

PROCEDURES

The researcher originally proposed a statistical analysis to test if there was a significantly higher mean of the pre-test post-test difference fot those students who visited the tutor as compared to the mean pre-test post-test difference of those who did not visit the tutor. Since the pre-test is a mathematics placement test based on the students achievements in high school mathematics and since the post-test is based on the students achievement in college freshman mathematics there is little relation between the two test so their differences would be meaningless.

As a result of this discovery the researcher will use the pre-test, along with other measures, to stratify his control group before randomly selecting the group. The statistical analysis will now test if there is a significant difference between the mean of the post-test for those who visited the tutor as compared to the mean post-test for those who did not visit the tutor.

Definition of the Terms

1) Academic Achievement - the final percentage average of the students completing freshman mathematics.

2) Control group - the students who were selected (matched pairs sampling technique) who did not make use of the tutor.

3) Experimental group - the students who made use of the tutor at least three times during the semester.

4) Dependent variable - post-test.

5) Independent variable - three or more sessions with the tutor.

6) Intervening variable - high school mathematics grades, age, sex, intelligence, motivation, health, marital status, social adjustment.

7) Post-test - the students final percent average for the semester.

8) Pre-test - a test administered the first day of class to aid in the placement and advising of students in mathematics classes.

Limitations of the Study

1) The extent to which York College mathematics courses compare to those of other institutions limits the external validity of the investigation.

2) Any of the intervening variables may limit the accuracy of the study.

3) The extent to which the post-test accurately reflects academic achievement and learning limits the accuracy of this study.

Basic Assumptions

1) It was assumed that the control group was matched with the experimental group to achieve reasonably homogeneous groups.

2) It was assumed that the possible intervening variables would not adversly affect the results of this study.

3) It was assumed that the limitations would not adversly influence the results of the study.

Procedures for Collecting the Data

1) The twenty-six students who visited the tutors three or more times during the semester were identified from the tutor's records. This was the experimental group.

2) The twenty-six students in the experimental group were then matched randomly with twenty-six students who did not visit the tutor during the semester. They were

first matched by pre-test scores and then the subjects were stratified and randomly matched on the basis of mathematics grades in high school, age, sex, intelligence, motivation, and marital status. This was the control group.

3) The following information was obtained for all fifty-two subjects:

a. Pre-test scores.

b. Post-test scores.

c. Number of visits to the tutor.

d. High school mathematics grades, age sex, intelligence and marital status.

Note - All information required for this study was obtained from records found in the computer center, records office, admissions office and mathematics office of York College of Pennsylvania.

Procedures for Treating the Data

1) A t test was utilized to compare the mean post-test of the experimental group with the mean of the post-test of the control group.

2) The following null hypothesis was tested: there is no significant difference between the mean of the post-test between the experimental and the control groups.

Null Hypothesis	$H_o: \bar{X}_1 = \bar{X}_2$
Alternate Hypothesis	$H_a: \bar{X}_1 > \bar{X}_2$
Level of Significance	$\alpha = 0.05$
Critical t Value (one-tailed test)	1.678

Degrees of Freedom 50

One-tailed Test 0.95 percentile value

H_o will be rejected and H_a accepted if $t > 1.678$.

RESULTS

The data resulting from the study is as follows:

Experimental Group	Control Group
$N_x = 26$	$N_y = 26$
$\Sigma X = 1702$	$\Sigma Y = 1500$
$\Sigma X^2 = 117,904$	$\Sigma Y^2 = 93,148$
$\sigma_x = 16.110$	$\sigma_y = 16.260$
$\bar{X} = 65.462$	$\bar{Y} = 57.692$

Critical t value = 1.678

Calculated t value = 1.731

The above table records the calculated statistics comparing the mean post-test of the students who visited the tutor (the experimental group) with the mean post-test of the students who did not visit the tutor (the control group). Designated respectively are: the number in each group; sum of the scores; sum of the squared scores; standard deviation; and mean. Since the calculated t value exceeds the critical t value at the 0.05 level, the null hypothesis is rejected and the alternate hypothesis is accepted. The researcher concludes that those students who visited the tutor achieved a higher post-test score than those students who did not visit the tutor.

DISCUSSION, IMPLICATIONS AND RECOMMENDATIONS

Discussion and Implications

It is clear that York College mathematics students who visited the tutor achieved more and learned more than those who did not. Furthermore, the tutorial program seems to benefit the college in other ways than grade improvement of its students.

From the results it can be seen that the mean final grade of the students receiving tutorial assistance was 7.77 percentage points above those students not visiting with the tutors. This is almost one full grade value. In addition, an examination of the Table of Raw Data in the Appendix will show that fewer of those students who saw the tutors received failing grades than those who did not see the tutors.

It appears that the results of this research justify making the experimental mathematics tutorial program a permanent college program. The success of the program suggest that it be expanded in both hours and scope. A similar program in English, the behavioral sciences and the social sciences should be of equal benefit for the students.

From the Table of Raw Data in the Appendix it can be seen that those students who visited the tutor are generally those students in the lower grade ranges. If the tutorial program allows these students to raise their grades from an F to a D or from a D to a C it should make a dramatic

impact on whether or not that student remains in college. Since York College has an "open door" admission policy the tutorial program provides a needed service for many of our students. In addition, to increase persistence the literature suggest that there will be less student withdraw from mathematics courses and other courses as well as an increase in the positive attitudes of the students. All of these factors should benefit the college.

Recommendations

Reed (1974) list the following as goals for an effective tutorial program:

1) To provide academic support for students who lack the educational background for college work.

2) To ensure student retention in college and subsequent graduation.

3) To help students develop self-concept.

4) To help students develop self-confidence and reduce feelings of fear and failure.

5) To improve human relations and the sense of campus community among students.

6) To provide individualized help.

7) To provide help in developing study skills.

8) To improve academic performance.

9) To improve basic skills.

10) To help students adjust to college.

Keeping this in mind the following recommendations are made:

1) A copy of this study will be given to the Mathematics Department and the Dean of Academic Affairs, recommending that the mathematics tutorial program be made permanent and expanded as necessary.

2) That other departments investigate the need for tutorial programs in their disciplines.

3) That campus facilities in a central location during convenient times be made available for all tutorial programs.

4) That a study should be done to determine the needs of the students campus-wide for tutorial assistance and ways in which that assistance can be provided to the students.

5) That a rigorous tutor selection process as well as a tutor training program should be investigated.

6) And that the current tutors should be commended for their positive contributions to the college and its students.

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TABLE OF RAW DATA

PRE-TEST	EXPERIMENTAL POST-TEST	CONTROL POST-TEST
25	23	8
25	57	60
27	32	38
30	66	54
40	74	62
41	89	46
42	61	63
45	67	60
48	50	41
50	40	30
50	66	56
57	62	48
61	73	56
64	60	49
69	70	55
70	75	68
70	76	68
74	63	52
76	62	61
79	77	71
79	83	70
81	63	74
85	60	69
85	90	70
94	78	80
94	85	81